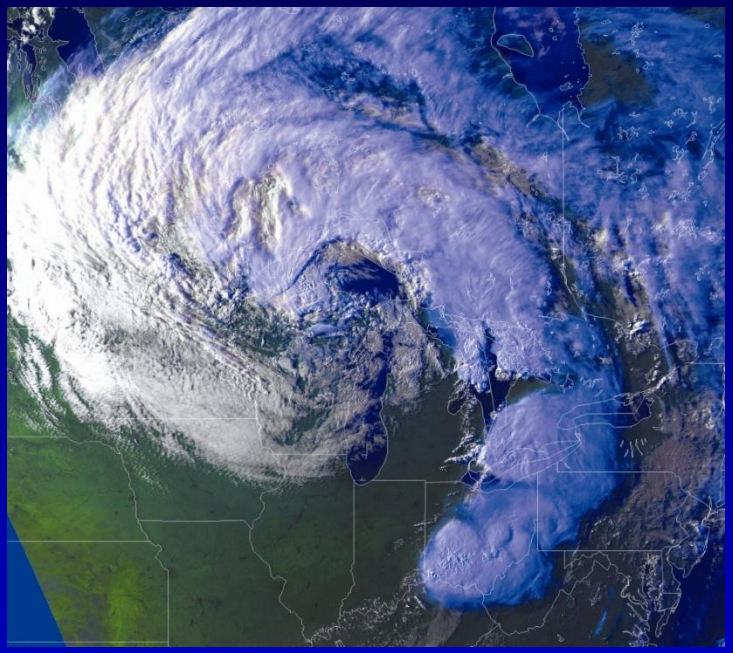
Educational Opportunities in GLISA: M. Eng. Applied Climate & Climate Impacts Engineering (U.G.)



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Great Lakes Integrated Sciences & Assessments

GLISA

Applied Climate / Climate Impacts Curriculum

Dept. of Atmospheric, Oceanic, and Space Sciences

- Goals:
  - to accelerate the use of climate knowledge in design, planning and management
    - Making potentially useful information into usable knowledge
  - Climate interpreters / translators
  - Ability to combine with other professional degrees
    - Urban planning
    - Public health
    - Public policy

From the *A National Strategy for Advancing Climate Modeling* (NRC, 2012)

- Identified the need for, “professionals who could perform tasks that are being done in boundary organizations at the interface between climate science and decision makers.”

- **Recommendation**: “To promote the effective application of climate models, the United States should develop climate interpretation certification and continuing education programs to train a cadre of climate interpreters who can facilitate the interpretation of climate model output into usable information for a variety of decision makers and communicate user needs to climate modelers.”

Knowledge System: Translation

- Need to bring together disparate information and different points of view to develop strategies for applied problem solving
- Key to development of successful strategies: iterative process or co-development with information providers and information users

Cash et al: 2002
Lemos & Morehouse, 2005
Dilling & Lemos, 2011

Skills and Subject Areas

- Scientific foundation in climate science
- Where to get data and information (Informatics)
  - Make that data and information usable
  - What are the barriers?
- Place that data and information in context
  - Knowledge of uncertainty
  - Knowledge of uncertainty in context
  - Place uncertainty into context
- Statistics, statistics, statistics
- Geographical Information Systems
- Problem Solving Skills
  - Theory
  - Application → Practicum

MEng. Curriculum

- Courses required of Applied Climate Program students fall into three categories:
  - Departmental Core Courses (5): Required of all AOSS MEng Applied Climate graduate students, includes 2 semester Practicum sequence
  - Program Core Courses (2): Required courses in this MEng Program, and those required of a concentration, if one is chosen.
  - Program Elective Courses (2): The AOSS courses or/and additional non-AOSS courses that support student's area of interest.

Formal Role of GLISA and UM Graham Institute

- Graham – AOSS (MOU): This Memo of Understanding (MOU) recognizes that the educational, research, and applications goals of both AOSS's MEng in Applied Climate and Graham benefit from a partnership that includes incorporation of AOSS students and faculty into the real-world projects associated with the Graham and its family of centers and programs. This is a unique alignment of interests and capabilities will accelerate the use of climate knowledge in the broader contexts of sustainable engineering, planning and management essential for our societal success.

Example Projects

- Lake Levels (Sustained Assessment)
  - Water Center
  - GLISA
  - National Park Service
- Freezing Rain Climatology
- Great Lakes “Ensemble”
  - Localizing climate-model projections to account for important lake-weather processes
- Guidance on use of Concentration Pathways.
- Freeze-thaw cycles
- Coupling Lake with Land Observations
- What can we say about trends in heavy precipitation?

Things we are doing

- MEng Applied Climate
- Climate Impacts Engineering
- Climate Change Problem Solving (Blogs)
  - AOSS / NRE 480

- Thinking about
  - 3rd Century Initiative
  - One-year certificate
  - Executive Masters
  - Joint program with School of Business

Questions?

Is there demand?

Some relevant references

- Lemos and Rood, Climate Projections and their Impact on Policy and Practice, WIREScc, 2010
  - Useful vs Usability (not the only ones)
  - Uncertainty Fallacy
- Rood and Edwards, Climate Informatics: Human Experts and the End-to-End System, Earthzine, 2014
  - Improving the usability of data systems and data services, data systems to support translation
- Barsugli et al., Practitioners Dilemma, EOS, 2013
  - Existence and access to data and knowledge not the primary problem, it is how to make the data and knowledge relevant to applications

Useful and Usability

- Scientists often talk about the usefulness of their data (observations or projections)
- Practitioners talk about the usability of data, information and knowledge
  - Practitioners?
    - Urban planners
    - Public health
    - Ecosystem managers
    - Water managers
    - …

Motivator: Interest (are there jobs?)

- In our RISA center, GLISA, we provide small grants to boundary organizations, we fund maybe 5 out of 50 good proposals
- There is no shortage of climate-change problems brought to us by NGOs, local governments, academic interests, (corporations?)

Graham – AOSS (MOU)

- "Hands-on" real-world projects have proved, uniquely, to move potentially useful knowledge about climate change into usable information in planning and management. Through participation in real-world projects, patterns of problem solving emerge, which allow structuring of end-to-end systems that link data, information, knowledge, planning, decisions, and actions.

Foundation of Course / Program

- Theory
- Engagement model
- What it means for data

Loading Dock Doesn't Work

Knowledge System: Translation

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Motivator: Environmental Behavior

- Hines, Hungerford, Tomera, Responsible Environmental Behavior, 1987.
  - We need to correct "[t]he erroneous assumption…that skills evolve naturally from knowledge"
  - What to do and the skills to do it
- Rood:Solving the Problems of Climate Change and Sustainability, Michigan Journal of Sustainability, 2, 2014.

Translation, Interpretation

- The chain from useful to usable can be viewed as translation
- What is translation?

Types of Translational Information

Basic Data

Applications
Global
Regional
Local

Model Output

Digital Information
Indices
Downscaled
GIS Formats
Seasonality

Fact Sheets
Summaries

Images
Figures

Assessments
IPCC
NCA
Local

Narratives
What has happened?
What will happen?
What are the impacts?

Guidance
Judgment

Observations
Quality Assessment
Homogeneity

Uncertainty Descriptions
Risk Assessments

Engagement Model

Engagement with cities (and others)

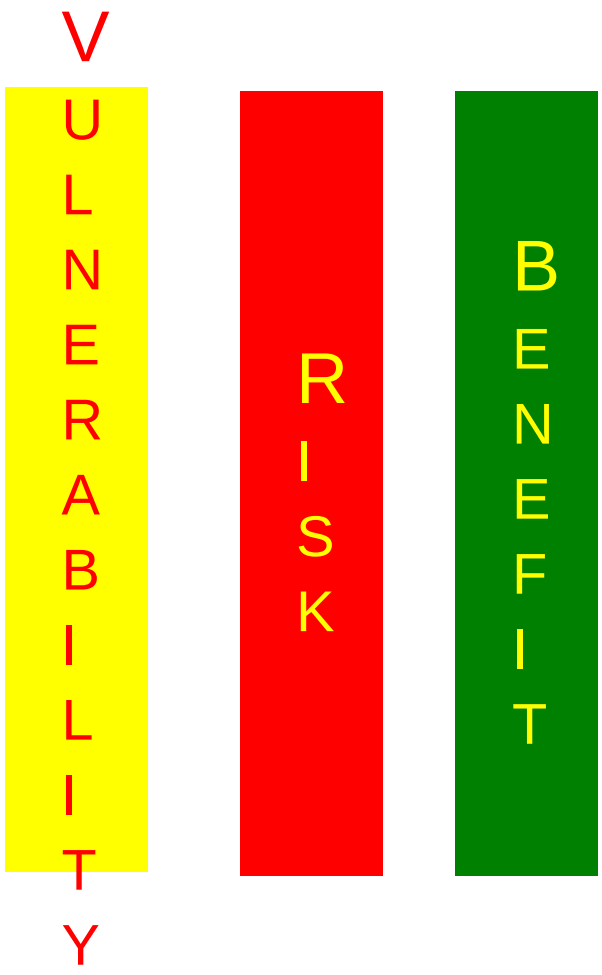
- Often the first question is what data are available and how do we get it?
- After discussions of data quality, uncertainty, evaluation and data manipulation we move to three questions:
  - What has happened?
  - What will happen?
  - What are the impacts or consequences?
    - GLISA Climate Information Guide

Experience from Climate Change Problem (We are early in this process)

http://www.glisaclimate.org/climate-information-guide

What Has Happened?

What Will Happen?



How Does Data Fit In?

Which Data?

- With our clients, most requested data sets
  - Station data from NCDC (National Climatic Data Center)
  - Model projections from Coupled Model Intercomparison Project (CMIP)
    - Tailored datasets derived from CMIP
  - Local data that represent region or application
    - Lake ice, stream flow, high resolution temperature,
    - Census data, built environment, …
  - Reanalysis data and satellite data

Data consequences of questions

- What has happened leads almost inevitably to weather station data
  - Trusted by locals and planners
- What will happen leads to use of projections
  - Climate Model Intercomparison Project (CMIP)
  - Downscaled versions of CMIP
  - Other sources of projection information

Data consequences of questions

- Linking what has happened (station data) to what will happen (model projections) requires evaluation of models relevant to the problem at hand
  - In most cases that we work on, handing the climate projections or downscaling data to practitioner is of little value
  - What is desired is a context based narrative description

Evaluation / Salience / Tailoring

- Evaluation of the data, information knowledge for the specific application is essential to usability.
- The need to provide data to be used in evaluation rather than to be plotted and used is a challenge to how we design data systems.
  - Especially because of the data use in applications
    - Need for application relevant data / indices

Alignment of information

- Here we see
  - Local observation or experience
  - Alignment with regional observations
  - Alignment with the narrative of the models
    - More precipitation in extreme events
  - Vulnerability
- Likely success in integrating climate knowledge in policy and planning

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NCPP

GLISA
GREAT LAKES INTEGRATED SCIENCES + ASSESSMENTS